Proposed Single Family Water Demand Study
Summary for Phoenix GUAC 2/10/16

Background:

Water use in Arizona and the Phoenix Metropolitan Area - defined by the Arizona Department of Water Resources (ADWR) as the Phoenix Active Management Area - has been declining on a per capita basis for over twenty years for a wide range of reasons. The reasons for these past and on-going reductions are diverse and often complex, and include changing federal fixture and appliance standards, state regulations, local campaigns promoting conservation, cultural transitions that have led to native landscaping becoming not only acceptable but desirable, and efforts by commercial and residential property owners to install more energy and water-efficient devices and processes.

Understanding the often complicated technological, cultural and economic dynamics behind this change can sometimes be difficult and time-consuming but is very important because the alternative – building infrastructure and obtaining additional water resources to accommodate inaccurate demand projections – can be far more costly. While often challenging and time-consuming, water demand research can pay huge dividends by providing information that allows utilities, state agencies and even the general public to better understand what has occurred, what is occurring right now, and what will likely occur five, ten and twenty-five years from now in the use of one of our most precious resources.

Two studies are being proposed that would utilize funding from the Arizona Department of Water Resources (ADWR) to further water demand research in the Phoenix Metropolitan Area – one that focuses on single family water use and one that investigates commercial, industrial and institutional (CII) water use. If ADWR funding is approved, the Cities of Chandler, Glendale and Phoenix and the Town of Gilbert would initiate the single family residential study first and then initiate the CII study when the residential study is either underway or has been completed. It is anticipated that Phoenix would manage the financial and legal aspects for the consultant contract for the single family study but that staff from Chandler, Gilbert, and Glendale would participate in the final project scoping, the consultant selection, the study itself and the review of consultant and other materials produced by the study. A similar arrangement would be used in the CII study except that Chandler would be the lead entity with primary responsibility for consultant contracting.

While the study would be of water use in Chandler, Phoenix, Gilbert and Glendale, it is expected that the results of the study would be broadly applicable to the entire Phoenix Metropolitan Area because the four municipalities combined have a combined population in excess of two million (over 50% of the Phoenix Active Management Area or AMA) and a housing stock that would provide excellent representative samples of single family units built between 1940 and 2010. Phoenix has a wide range of single family housing that includes developments built in each of the decades following the Second World War and that span the full range of property values and unit and parcel sizes, while Glendale has many units built in the 1960s and 1970s, Chandler has a wide range of homes built between 1970 and 2010, and Gilbert has a housing stock that was largely constructed since 1990. Together these four municipalities provide a diverse but manageable study area that will capture the diversity in housing types and associated water use that is found in the Phoenix Metropolitan Area.

Research on single family water use has been conducted across the U.S. for several decades, at different levels of scale and detail depending on type of user and geographic location. While very

useful, the national studies have tended to provide only limited information on two areas that are needed for understanding past and current water use, and for projecting future water use, in the Phoenix Metropolitan Area.

The first area of deficiency exists in the data on the existence of relatively-inefficient fixtures and appliances in the older homes built between 1940 and 2000. To truly understand water use and what kind of future reductions can be expected, better estimates of device characteristics in specific housing cohorts (e.g. homes built between 1970 and 1980) are required, and to obtain this, data-logging and surveys of larger samples must be undertaken.

The second area of deficiency involves outdoor uses. With a tremendous range of landscapes and a high incidence of pool ownership, the Phoenix Metropolitan Area poses unique challenges for interpreting outdoor water use that few other parts of the country do. National studies have tended to focus on simplistic variables such as total turf and expected irrigation requirements using ET rates when analyzing water use; in the Phoenix Metropolitan Area where homes with partially desert vegetation or mostly desert vegetation are now in the majority, studies of residential water use must use more sophisticated types of classification to understand demands.

Studies have been conducted in past years by Aquacraft and more recently by Montgomery and Associates to examine trends in single family water use. However, while extremely useful for showing conclusively that single family home indoor use is falling in virtually all locations, and that outdoor use is falling in many locations, these studies still lack the type of extremely-detailed water use and device/landscape inventory research that is needed on a larger scale that would permit the kind of analysis and projections that are sought. More specifically, more extensive primary research is needed to answer the following types of questions with a reasonable amount of accuracy:

- What types of appliances and fixtures are found in which types of homes (age cohort, size, value, etc.), which would in turn provide valuable insights into replacement rates and the rate of change in water use that can be expected in indoor use over the next two decades;
- To what extent is the adoption of efficient appliances and fixtures, and the level of use of those devices, consistent within municipal utility territories, within the Phoenix Metropolitan Area, and between the Phoenix Metro area and other urban areas in North America;
- What impact specific outdoor characteristics such as general landscape type (e.g. mostly desert, partially desert, partially desert with some turf, mostly turf, etc.), pool, irrigation system (e.g. multi-zone drip, drip, drip/spray, all spray, etc.) and presence of native or non-native plants have on water use;
- To what extent have single family homes made the transition from turf and non-native plant dominated landscapes to those that have far less water-intensive landscapes (which would in turn provide valuable insights into replacement rates and the rate of change in water use that can be expected in outdoor use over the next two decades);
- What are the causes of the variation that exists between homes with generally similar landscape categories (e.g. over-watering; deficit-irrigation; more native species; better irrigation systems; etc.);
- To what extent neighborhood cultures, home age, occupant characteristics, home owner association (HOA) restrictions, incentive programs, water rates, or other identified factors affect (or don't affect) specific drivers like landscape type or device use have had a major impact on indoor and outdoor water use.

The proposed single family residential study would attempt to bridge current information gaps (identified above) by undertaking extensive primary data collection and analysis by a consultant in a relatively large sample of at least 400 homes in four different municipal utility areas that together have

a large base of homes in a broad range of age cohorts, neighborhood types and demographic characteristics. Intensive information collection within this core of approximately 400 homes would be supplemented by analysis of aerial imagery, data-logging, regular water data analysis, and potentially site audits of additional homes by staff from the four participating utilities.

Overview of Project Responsibilities:

The consultant will be responsible for undertaking a 'core' study of approximately 400 homes that will replicate previous national single family water use studies like the 1996, 2009 and 2015 national REUWS studies and the 2012 California study that relied heavily on data-logging of samples of individual homes to provide detailed estimates of appliance and fixture water demands (i.e. gallons per wash or flush) and estimates of appliance and fixture usage rates (i.e. number of washes or flushes per household/person per day). The consultant will also undertake a review of aerial imagery or other data for the core-study homes to categorize landscapes in a manner that will allow for the detailed estimation and explanation of irrigation practices. It is anticipated that the consultant will assist the municipal utilities (Chandler, Gilbert, Glendale and Phoenix) with the interpretation of any supplemental data collected in the study (additional data-logging, aerial analysis, on-site auditing, sewer metering, or use of regular and AMI/AMR meter records) and developing an analytical framework for integrating all of the available information into one cohesive study. If possible, the consultant will retain the services of sub-consultants to assist with specific, limited activities such as identification of trends in appliance and fixture manufacturing and distribution.

The municipal utilities will be responsible for assisting with the identification of target sample of homes (and backup replacements), installation and interpretation of any data-loggers that are in excess of those required for the core study, provision of regular and AMI/AMR meter records, provision of aerial imagery for both 'core' and 'supplemental' single family residences, and any auxiliary research involving site visits/audits. It is anticipated that municipal utility staff will also play a key role in providing background information on trends, expertise on irrigation usage in the Phoenix Metropolitan Area, guidance on the development and use of landscape categories, and auxiliary research that can verify, supplement or modify findings by the consultant.

Estimated Costs and Resource Requirements:

Consultant Services and Associated Costs

Data-logger installation and collection/analysis using of signatures using Trace Wizard: $400/home x 400 homes = $160,000

Distribution and coding of 5,000 surveys (expected rate of success 30%): $20,000

Analysis of landscaping (including pools) and reconciliation with Trace Wizard irrigation signatures: $80/home x 400 homes = $32,000

Assistance with analysis of Trace Wizard reads taken from data-loggers used by municipal utilities: $30,000

Total: $242,000

In-Kind Services Provided By Municipal Utilities

Data-logger installation and collection: 400 homes

Analysis of signatures using Trace Wizard: 400 homes (focus on fixture/appliance identification)

Analysis of landscaping and reconciliation with Trace Wizard: 400 homes

Irrigation audit of homes (try to understand variation within landscape type categories): 40 homes

Indoor audit of homes to identify fixtures and appliances (verification of Trace Wizard results; try to understand anomalies): 40 homes

(Optional) Use of AMI/AMR meters at selected sample homes (that will be data-logged) to determine viability of substituting advanced meter data for data-logging data in conducting certain types of analysis: 20 homes

(Optional) Contact with regional retailers to obtain data on appliance and fixture sales (by type/water use): Unknown time requirements

(Optional) Use of systems like eCognition to evaluate landscapes in an automated fashion

(Optional) Data analysis and interpretation/model development

Estimated Time Requirements:

Scoping, consultation, research set-up and mobilization phase: 6 weeks

Core sample data-logging installation, collection, down-loading by consultant: 4 weeks per 100 homes with assumption of 400 homes in the primary core sample => 4 x 4 = 16 weeks

Core sample trace analysis by consultant: 6 weeks per 100 homes with assumption of 400 homes in primary core sample => 6 x 4 = 24 weeks

Survey of core sample homes: 12 weeks (can run concurrently with consultant data-logging and trace analysis segments)

Integration of data and analysis: 6 weeks

Total study time: Approximately 6 weeks + 16 weeks + 24 weeks + 6 weeks = 54 weeks => roughly one year

STUDY TIME COULD POTENTIALLY BE REDUCED CONSIDERABLY IF UTILITIES INSTALL AND COLLECT SOME OR ALL OF THE DATA LOGGERS IN ADVANCE